STEWART, (D.D.)

A

With kind regards,

CLINICAL ANALYSIS

OF

SIXTY-FOUR CASES OF POISONING BY LEAD CHROMATE (CHROME YELLOW), USED AS A CAKE-DYE.

BY

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ASSISTANT PHYSICIAN TO ST. CHRISTOPHER'S HOSPITAL
FOR CHILDREN.

Presented by the author

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A CLINICAL ANALYSIS OF SIXTY-FOUR CASES OF POISONING BY LEAD CHROMATE (CHROME YELLOW), USED AS A CAKE-DYE.[1]

BY DAVID DENISON STEWART, M.D.,

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IN presenting to the profession through THE MEDICAL NEWS of June 18, 1887, some hastily prepared notes on several cases of lead-poisoning, whose source I had traced to the use of lead chromate as a food adulteration, I was unaware of the rather extensive use of this substance as a food color and of the wide prevalence of lead-poisoning through this means. The present paper is an analysis of the symptoms of sixty-four of these cases, fifty-seven of which I have personally carefully examined. All of them had consumed, for a considerable period, large quantities of the cakes containing the lead chromate and all showed some unmistakable signs of plumbism, which, by diligent inquiry, I was unable to trace to other sources. I have excluded some cases which I have no doubt are due to lead, presenting none of what are ordinarily regarded as the essential symptoms of plumbism, such as the

[1] Read before the Philadelphia County Medical Society, September 14, 1887.

blue line on the gums, colic with constipation, arthralgia, etc., time not permitting examining the urine for the metal. I prefer to deal here almost solely with the class presenting the ordinary symptoms more or less pronounced, concerning which, there can be no question as to diagnosis. I have found that there is a much larger class with symptoms more or less obscure and not especially suggestive of plumbism, but whose condition is, nevertheless, due to the action of lead and deserves most careful consideration and study. They make a far more instructive group than these here considered, since, because of the obscurity of their symptoms, serious mistakes in diagnosis are constantly being made.

I have met a number of these cases recently, which, though I believe there can be no doubt as to the nature and source of the symptoms, I prefer not to discuss as a group until I can, at the same time, present the results of the urine analysis which Dr. Leffmann is now carrying out. In the present group are a few, for example, one of the cases of encephalopathy (Mrs. V. G.), that approach those that present so-called "classical" symptoms of lead-poisoning, there being some few features in common; yet of them, those in the latter are obscured by more prominent symptoms not generally considered suggestive of plumbism. In a subsequent paper, the material for which is being collected, some cases of this sort will be discussed and the results of the tests for lead in the urine given.

The sixty-four cases here considered include nearly all that first came to my notice due to the introduction of lead chromate into the food furnished by the two bakers, Palmer and Schmid, who were recently held by the coroner to await the result of a judicial inquiry. They do not by any means

include the whole number affected. From subsequent observation I am convinced they are only a modicum and that the extent of the evil is not yet fully known.

Of these 64 cases 32.81 per cent. (21) are males and 67.18 per cent. (43) are females. This large excess of females affected may be explained by their greater fondness for the food containing the lead salt. Both sexes appeared to be equally susceptible to the metal and each suffered with equal severity. Of five women who exhibited symptoms of plumbism during gestation, none aborted, but all at full term gave birth to living children; one had, however, two convulsions at the termination of the seventh month of pregnancy, believed to be of saturnine origin, though a small amount of albumen was present in the urine. Four of these five infants had convulsions within two months after birth, in which two died.

78.21 per cent. (50) of the cases exhibited the saturnine cachexia, displaying an anæmic appearance with an earthy-yellow hue to the skin; a sallow tint without yellowness was present in the remaining 21.87 per cent. (14). In 10.93 per cent. (7) the skin became intensely yellow at one time or another, notably when colic was present. The dull, anæmic, somewhat listless look, associated with a peculiar fulness of the cheeks, of which Oliver[1] speaks, and which is considered by him as quite suggestive of plumbism, I noticed in but three cases. Emaciation was present in nearly all who had been affected for several months and in some was marked.

In a large number neurasthenic symptoms antedated for a considerable period the outbreak of

[1] Brit. Med. Journal, Oct. 17, 1885, p. 732.

colic, arthralgia, or encephalopathy. Many recalled that for days and weeks prior to the development of marked symptoms of plumbism they were affected with progressive muscular weakness, the slightest exertion causing fatigue, and often aching in the lower extremities; they had vague pains in various parts of the body, loss of flesh, mental depression, the skin had become sallow, they had passed restless nights, were affected with insomnia and arose in the morning totally unrefreshed.

Among the neurasthenic symptoms to be especially noted are: the mental depression, which was a prominent symptom in 54.68 per cent. (35), in several it approached melancholia; marked impairment of memory present in 17.18 per cent. (11); great prostration and weakness, the slightest exertion causing fatigue, present in 54.68 per cent. (35) —the fatigue was especially marked on rising in the morning, and may have been caused in part by obstinate insomnia, with nocturnal restlessness, of which the same number complained; vague neuralgic pains as a portion of the neurasthenia—apart from severe arthralgia—were present in 9.36 per cent. (6); 7.81 per cent. (5) made complaint of general pruritis, unassociated with icterus, and the same number of cutaneous and muscular hyperæsthesia. These symptoms were, in nearly all classes of cases, associated with those indicative both of disordered primæ viæ and of the specific action of the metal on the gastro-intestinal apparatus. There were very few of the sixty-four that had not more or less pronounced anorexia, associated with a heavily furred tongue, and a very fetid breath, which in some cases was so peculiarly so as to deserve the name metallic. 32.81 per cent. (21) spoke of a bad taste, which 2 described as per-

sistently sweetish; 1 as metallic; 1 as sulphurous, and 4 as sour; 13 were unable to describe theirs intelligently. Nausea was present in a large number, and in several who vomited very little, if at all, and had no colic. Colicky pains of all sorts, severe and light, and attended by more or less constipation, were present in 76.56 per cent. (49), and 60.93 per cent. (39) exhibited the phenomena of pronounced lead-colic. These pains were felt most often about the umbilicus, and following that in frequency about the epigastrium; they were in 53 per cent. (26) of the (49) cases relieved by firm pressure when applied gently and were accompanied by obstinate constipation in 55.10 per cent. (27); and moderate in 34.68 per cent. (17); obstinate constipation, alternating with severe diarrhœa, was present in 1.55 per cent. (1). Agonizingly severe loin pains coexisted with 19 cases of pronounced colic.

The peculiar character of the pulse—diminished in frequency and increased in strength and volume—usually considered one of the characteristic features of lead colic, I did not find present in the five cases I saw in the paroxysms; in these it was frequent and of only moderate strength and volume.

One of these cases was a patient of my own and was of peculiar interest because of her symptoms closely resembling hepatic colic. She is a woman weighing over two hundred pounds, whose first noticeable symptom of plumbism was attacks of exceedingly severe colic always appearing suddenly, and having their seat in the right hypochondrium and thence radiating to various parts of the abdomen and back. They were usually preceded for a day or two by slight colicky pains in the region of the gall-bladder and epigastrium, with constipation, anorexia, and an icteroid hue of skin.

There was always during the attacks tenderness on superficial or deep pressure over the hypochondriac region, and the abdomen was distended rather than contracted; constant nausea and frequent vomiting were present, the vomited matter consisting largely of bile; the bowels were much constipated and the scybalæ voided were clay-colored; the urine was concentrated, scanty, and contained a large excess of urates, but no albumin or casts. The attacks rarely lasted over eight or twelve hours, being checked without much difficulty by free use of morphine and atropine hypodermatically. Because of her general condition, habits of life, and her known fondness for sweets and fats, colic due to the passage of gall-stones was at first suspected and treatment was instituted for that affection, her feces being carefully washed and strained, but no stones were ever detected. Her gums, which were much retracted, showed a faint bluish streak along the lower incisors. She subsequently developed more marked symptoms of plumbism, but under potassium iodide made a rapid and continuous recovery, entirely regaining color and losing the constipation.

The frequency of the presence of vomiting in all classes of cases, and particularly in those with epigastric and umbilical pains deserves more than passing notice, and would seem to indicate a special irritant action of the lead chromate. It occurred in 81.63 per cent. (40) of the forty nine cases of light and severe colic, and in eleven (17.18 per cent of the sixty-four) cases in which other symptoms than colic were present. It was present, therefore, in 79.68 per cent. (51) of the whole number of cases and was nearly always severe. The vomited matter had a greenish-yellow or greenish hue. Nausea preceded vomiting and was a quite constant symptom in a few of the sixty-four who did not vomit. Tan-

querel, who saw a very large number of cases of plumbism, recorded 1217 carefully studied cases of lead-colic; he found vomiting present in only 33 per cent. (412) of the 1217, and rarely if ever observed it with other manifestions of lead disease than colic. I believe the abdominal pains in all of the 49 cases were colicky and not inflammatory, though I am unable to be as positive regarding this point as I should like. Against it in a minority were the facts that firm pressure seemed to aggravate them greatly, and the abdomen in several cases was distended during the paroxysms. The pulse, too, during the paroxysm in at least 5 cases was far from being characteristic of lead colic. The color of the vomit was probably due to bile and not to the lead chromate, for Tanquerel mentions a somewhat similar colored vomit in his cases which were not due to poisoning by this particular salt of lead, and this same character of vomit continued in many of the cases, at intervals, for several weeks after the poison had ceased to be ingested.

It has been ordinarily supposed that lead chromate is soluble to a very limited extent in the intestinal juices, and hence its ingestion in small quantities cannot give rise to serious symptoms, though Schuchardt[1] states that it appears to act as a corrosive poison and more powerfully even than the acetate, while Wharton[2] and Stillé suppose it is more or less insoluble, though they believe it sometimes gives rise to acute poisoning owing to its decomposition after it enters the body. Owing to this fancied insolubility and the number of cases now indubitably traced to its use as a food-dye, it might be thought

[1] Maschka's Handbuch der Gerichtlichen Medicin.
[2] Medical Jurisprudence.

that the samples used by bakers contained lead carbonate as an adulterant and that the poisoning was due to the latter more soluble salt, but Dr. Leffmann has recently ascertained by experiment that, while the commercial samples do not yield lead to distilled water or carbonic acid water under pressure, notable quantities are dissolved in a short time by dilute solutions of the ordinary household acids, citric and acetic, and also by very dilute solutions of hydrochloric acid, or by very dilute solutions of hydrochloric acid and pepsin. The non-solution of lead from commercial lead chromate by carbonic acid under pressure indicates that the samples tested, which include that obtained from Palmer, do not contain lead carbonate. These facts set at rest the question of insolubility, and explain the ease with which poisoning occurred; especially when one reflects that the lead was taken with the food, at a time when it could most readily meet the agents necessary for its solution. No doubt, decomposition rapidly follows its ingestion, and soluble chromium and lead salts are formed which diffuse into the blood.

That the various salts of chromium do act as local and systemic irritants, there can be no reasonable doubt, one has but to consult the various works on toxicology and jurisprudence[1] for abundant evidence on this point. Lead chromate, because of its supposed non-solubility in the stomach, has been thought less toxic than any of the other chromium salts, though Von Linstow[2] and Leopold[3] report 3 cases of

[1] See Taylor's Treatise on Poisons. Maschka's Handbuch der Gerichtlichen Medicin; Wharton and Stillé's Medical Jurisprudence; Falck's Lehrbuch der Practischen Toxicologie.

[2] Vierteljahrschrift für gerich. Med. u. öffentl. Sanitätswesen Band xxi. 60.

[3] Ibid. Sanitätswesen, Band xvii 29

acute poisoning due to it, occurring in very young children,[1] and terminating in death in a very few days, in which the autopsy revealed extensive signs of the action of a corrosive poison, such as softening, ulceration and perforation of the stomach and duodenum, etc., though the amount of lead chromate ingested in each of Von Linstow's cases was said not to have exceeded the one-fifth of a grain. In these latter cases, from the character of various symptoms present and such marked signs of the action of a corrosive poison found post-mortem, as well as from the smallness of the quantity of lead chromate taken, it may be that potassium bichromate, and not lead, was the active toxic agent. In the recent fatal cases it is unfortunate that the viscera were not examined with reference to the action of a corrosive poison. Of the two under my charge, in one, the gastric symptoms were apparently almost nil, in the other, though lead poisoning was suspected to be the cause of death, the source of the poisoning not then being ascertained, the particular salt ingested was not known, and the viscera were removed with as little handling as possible, exclusively for chemical examination.

The abruptness of the seizures in many of the recent cases might suggest acute poisoning, but in all of them, by careful inquiry, I succeeded in eliciting a history of some signs of failing health for at least a brief period prior to the onset of the seizures, and in many of slight colicky, arthralgic or head pains suggestive of plumbism. All, too, showed the sallow skin, and none of this class was without at least a faint blue line on the gums. The four members

[1] Leopold's case was æt. 2 weeks; Von Linstow's were æt. 1¾ and 3½ years respectively.

of the Helm family, whom I saw through the kindness of Dr. Hellyer, were notable examples of this; it was ascertained that in these some of the above-mentioned symptoms had been present in a slight degree for the space of a week or ten days prior to the marked outbreak of their trouble, which occurred on June 18th. They were then within a day or so of one another taken suddenly ill; their principal symptoms being, collectively, nausea and frequent vomiting, often uncontrollable, the vomited matter having a yellow or greenish-yellow hue; heavily coated tongue; exceedingly fetid breath; severe, paroxysmal colicky pain above the umbilicus, aggravated by food and apparently by pressure, but decreased by warmth and poultices; severe pains in the loins. Very obstinate constipation was present in all save Annie Helm, whose bowels could be moved without trouble by mild purgatives and whose passages were described to be exceedingly yellow. All had very severe pains in the knees and ankles unattended by heat, redness, or swelling in any save Mr. Helm, who, after a few days, had an attack of acute articular rheumatism as a complication. Violent continuous cephalalgia was present in Annie[1] alone and was the precursor of convulsions, which appeared on the fifth day. The convulsions were at first local but soon became general, violent, and long-continued; in the intervals she lay in a comatose state and died on the eighth day. The skin of all was sallow, Mr. H. and Annie becoming quite jaundiced, and on the gums of all could be seen a slate blue line.

In some of the Palmer cases, for example, the

[1] Notable quantities of lead were found in her viscera by Drs, Reese and Leffmann, vide THE MEDICAL NEWS, Aug. 27, 1887. p. 231, Case v.

first two children, Charles, æt. 7 years, William, æt. 10 years, which, from not being able to get detailed histories, I have excluded from the cases here analyzed, symptoms were present indicating the action of an irritant poison. They were seized, one on May 9th, the other on June 27, 1884, suddenly with nausea, vomiting, abdominal pains, great prostration, and continuous convulsions, and died within 24 to 36 hours after the onset of the symptoms. They were both, from all I can learn, thought to be in good health on the morning of the day of seizure, and were known to have eaten largely of the baker's colored cakes on that day, while one, in addition, drank quantities of lemonade. I have notes of a case resembling these as regards the abruptness of the onset, which, however, did not have a fatal termination. It was that of a boy of 12 years, who, some hours after a hearty meal of dyed cakes procured from Palmer, was seized with identical symptoms. He has since come under my observation suffering with lead cephalalgia and arthralgic pains in the knees and ankles. Six cases, similar to the last, exhibiting symptoms of acute poisoning due to the same cause, were reported in the *Medical Times and Gazette* of December 24, 1859.

Arthralgia was present in 73.43 per cent. (47); in 56.25 per cent. (36) it affected the inferior extremities, including the loins, only; in 17.18 per cent. (11) it was more or less general. In 64 per cent. (41) it was severe, agonizingly so in a few; in the remaining (6) cases it was slight, and in all the pains in the lower limbs were of greater severity than in the upper. In 37.50 per cent. (24) it was associated with headache, which, in most of the instances, appeared simultaneously; in 20 of these the headache was severe, in 4 mild. Severe arthralgia, without any

preceding or following colic, but with usually cachexia, disordered primæ viæ, and (in two) constant diarrhœa, occurred in 8 of the 47. In 10 cases the arthralgia preceded for a considerable period the colic and other symptoms, save cachexia and debility; in 29 cases it occurred coincidently with or following colic. The flexor surfaces of the knees and ankles and usually the flexor muscles about these joints, were most affected; cramps in the calves and posterior and outer aspect of the thighs were frequent accompaniments of the pains. In several burning pain was felt in the soles of the feet and in the toes, accompanied by a hyperæsthetic condition of the skin of the same parts. In the 11 cases in which the superior extremities in addition to the inferior were affected, the pains were less severe above than below, and here, too, showed a preference for the flexor surfaces. The pains of all were acute and burning, or dull and aching in character, were always worse at night and never accompanied by inflammatory conditions, such as heat, redness, or swelling, save in the case of Helm, mentioned on page 755. They were in all assuaged by pressure and friction, but in many, increased by motion, and their onset was often preceded by ataxic symptoms in the limbs.

Many made complaint of a dull aching throughout the whole body, referring it especially to the osseous system. It was particularly marked at night and usually antedated colic and arthralgia.

Paralysis of the extensor muscles of the forearm, typical wrist-drop, occurred in only two; in both it was bilateral and seemingly complete. I was unable in either case to get the electrical reactions, because of ignorant opposition on the part of the subjects and their friends. In three cases there was slight

ataxia of the extensors of the wrists and fingers, but paralysis did not occur.

Headache was present in 73.43 per cent. (47); in 67.18 per cent. (43) it was more or less constant for a considerable period, with exacerbations and remissions, and of sufficient severity to indicate involvement of the deep cranial structures. In 35.93 per cent. (23) it was present without arthralgia. It was felt most severely and frequently in the frontal regions, and, following that, in the occipital; in a few it was equally severe and constant in both regions. Some, in addition, complained of pain in the nucha, and in a small number the pains were equally distributed about the head.

Encephalopathy was present in 23.43 per cent.[1] (15); in 17.18 per cent. (11) it was manifested as eclampsia; in 2 (3.12 per cent.) as delirium; in 1 as a modification of the delirious form, melancholia with accompanying hallucinations and delusions; and in 1 as coma. The eclamptic seizures were of epileptiform type, and were preceded in 10 of the 11 cases for days or weeks by other manifestations of saturninism, such as cachexia, colic, arthralgia, or severe continuous headache; and in at least 5 of these they occurred primarily, during or immediately subsequent to an attack of colic and arthralgia. In at least 4 of the 10, excruciating cephalalgia preceded for several days their outbreak.

[1] If three of the earlier Palmer cases, the two boys before mentioned and the first Mrs. Palmer, were added to these, this percentage would be raised to 26.86 or 18 cases out of 67, and that of the eclampsic variety to 20.89 or 14 cases out of 67. They were undoubted cases of lead eclampsia, and are excluded from this paper only because the lack of detailed history renders them unavailable for statistical purposes.

The convulsions were in all, general, severe, and in several, violent. The duration was longer than that of idiopathic epilepsy, the clonic stage often continuing upward of a half-hour, during which the tongue was known to be bitten in at least 6. The intervals in the 8 fatal cases were exceedingly brief, the convulsions rapidly recurring, until death took place in from eight hours to four days. In these, too, after the first few seizures, consciousness was entirely lost, and stupor or coma persisted until dissolution. I was unable to discover that an aura preceded the convulsive attacks in any of the 11 cases save 1, yet it may have in all; in this one it preceded only three spasms out of several. In 7 of the 11, I was able to discover the probable time existing between the first exposure and the appearance of the convulsions, during which lead was constantly ingested. In one it was 15 days; 32 in another, and 33 in a third; 2¾ months in a fourth; 4 months in a fifth, and 4⅔ months in a sixth—these were all members of one family; in a seventh it was about 2½ months.

This last case presents several points of interest. It may be one of a type which is occasionally overlooked. It is that of Mrs. S., aged thirty years, of good previous health, who had eaten from early in April, 1886, for a period of fourteen months, almost daily of the dyed cakes. For one-half of this period she ate daily from four to six of the buns, frequently then partaking of nothing else at the morning or evening meal. For two or three months anterior to her confinement on May 23, 1886, she began losing strength, was restless and sleepless at night, rising in the morning weak, enervated, and listless; she had anorexia, occasional

nausea, vomiting, colicky pains, and constant dull aching in the knees and ankles; her skin became sallow and pruritic, and the bowels constipated. About June 15, 1886, during an attack of severe headache and of what presented the phenomena of mild lead-colic, save that diarrhœa alternated with constipation, she had a violent epileptiform convulsion, lasting nearly an hour, during which she severely bit her tongue, as she did in all subsequent convulsions; no aura preceded. On July 6, 1886, all the less pronounced lead symptoms continuing, she had three convulsions in the space of three hours; severe headache and slight colic preceded for two or three days. On the 25th of the same month, after a day or two of colic and headache, she had a number of convulsions lasting four and a half hours, with intervals of unconsciousness. In December, 1886, and March, 1887, they recurred, preceded by the same symptoms, and now, for the first time, prior to these and the last convulsions occurring at midnight on May 28, 1887, she had a distinct sensory aura of numbness and tingling throughout the body immediately preceding, and she felt a seizure imminent. The spasm of May 28th was very violent, and was preceded for a few hours only by abdominal cramps, which appeared during the evening after eating a number of particularly yellow cakes at her noon lunch.

I saw her early in August last for the first time, she then had been for months under the treatment of irregular practitioners, who had been unable to discover the nature or source of her malady; she presented marked symptoms of plumbism with pronounced lead cachexia. There were present in addition, frequent attacks of syncope by day, and at

night delirium accompanied by limited clonic spasms. There was a pronounced blue line along the lower gum, which was much retracted from the teeth; in the upper gum where no teeth existed, no blueness could be discovered. Her heart was over-acting with a ringing, apical second sound. The urine was found to contain lead in notable quantities, but though repeatedly carefully examined for albumin and casts none were at any time found. She was under treatment for a short time and improved; I then lost sight of her. I have since understood that she has developed delusional mania.

One of the two cases of the delirious variety of encephalopathy has been already described;[1] the other was a more pronounced one. It was that of a girl, E. B., aged eighteen, who was profoundly saturated with lead through baker Schmid's cakes. Preceding a marked outbreak of arthralgia and encephalopathy she had symptoms indicating mental and physical exhaustion; she entirely lost her memory, was incapable of exertion, and was constantly wearied; there were present well-marked lead-cachexia, total anorexia, coated tongue, fetid breath, frequent nausea, and vomiting of a greenish-yellow fluid, obstinate constipation, an intense blue line on both gums, so marked that it was noticed by her acquaintances, but at no time did she have colic. She had three or more seizures, lasting two or three weeks at a time (with a number of minor ones), in which she was almost constantly delirious with very brief lucid intervals. They were always preceded for a day or two by intense frontal headache and exceedingly severe pains in the knees,

[1] The Medical News, June 18, 1887, p. 679; Case VII.

calves of the legs, ankles, soles of the feet, and, occasionally, the loins. There were intermissions of about a week between the attacks, and all her symptoms were aggravated at night.

The case of melancholia with accompanying delusions deserves at least brief consideration. It was referred to on page 753 and is of interest because the absence of the more pronounced symptoms of lead-poisoning caused it to be mistaken by two physicians for several quite different affections. The following are the points briefly given:

Mrs. V. G., aged twenty-two; no children; had been for months a hearty eater of Palmer's dyed buns; in excellent health up to three and a half months ago, then began to grow progressively weak, was easily wearied, the slightest exertion causing great fatigue; she suffered with insomnia, was depressed mentally, and there were constantly present such disorders of the digestive apparatus as coated tongue, foul breath, bad taste, frequent nausea with occasional vomiting, especially after food, mild constipation, and occasional slight colicky pains in the left lumbar and inguinal regions. There were also total anorexia, and earthy-yellow hue of skin, and severe, constant, dull, aching pains in the knees, with a feeling of soreness in the feet. Violent occipital and frontal headache appeared shortly after she began to fail in health and soon became constant with remissions and agonizing exacerbations often associated with transient amblyopia. About the same time she was affected with subjective and objective vertigo, the slightest exertion causing giddiness. Since the headache and vertigo have been present she has frequent hallucinations and delusions of sight and hearing, among others, she would

imagine she was approached by persons, who did not exist, with whom she would carry on lengthy conversations. During and following these spells she becomes exceedingly despondent and has dismal forebodings.

At the present time, in addition to the above symptoms, she complains of slight ataxia of the forearms, though the muscles respond normally to faradism and galvanism. The heart is overacting with an accentuated second sound at the apex and high tension in the pulse at the wrist. Various specimens of her urine were carefully examined for albumin at different times, but always with a negative result.[1] As her sight had recently failed somewhat, the eye-ground was examined by Dr. Hansell, who reported that "in the right eye the nerve is oval; the upper and outer quadrant is lined with pigment; the lower part is clear and sharply bounded. There is venous pulsation; the arteries are slightly swollen, more so than normal. The above conditions are even more pronounced in the left eye." The gums of this case did not show what is ordinarily regarded as a "blue line," but within the thin margin of gum grasping the neck of the upper left central incisor could be seen by careful inspection with the naked eye, and more easily with a single lens of moderate power, a number of bluish-black dots which were undoubtedly lead. A piece of white paper pushed up under this edge of the gum, between it and the neck of the tooth, brought out the dots with great distinctness.

[1] Her urine was not examined for lead until she had almost entirely recovered, and had discontinued the potassium iodide. It was then resumed for a few days, and a sample collected. Several tests were made of it by Dr. Leffmann, and distinct traces of lead found.

The thin edge of gum about the necks of the lower central incisors showed this pigmentation somewhat more plainly.

The patient[1] with the comatose variety of encephalopathy presented very much the same symptoms prior to the full development of the encephalopathy as the cases whose histories I have just related, so no detailed description need be given. He was profoundly affected by lead. With him, intense frontal headache, which he described as "deep-seated," and very severe arthralgia of the lower limbs preceded, for a short period, the coma. Though there had been marked gastric derangements, with the various manifestations of lead-colic, it was less evident at that time. So far as I could learn, he had but one attack of coma, very prompt treatment preventing a repetition; this appeared suddenly, during severe headache and arthralgia; he was totally unconscious and remained in this condition for seventeen hours. A careful examination of the urine showed there was no associated kidney trouble.

Encephalopathy is undoubtedly the severest and probably the most infrequent of all the manifestations of lead-poisoning. It has been met with almost exclusively among those whose work favors a copious absorption of the metal. There seems slight doubt, from the large percentage among these 64 cases which are probably but a small part of the number poisoned by the two bakers, that the affection has been more than once overlooked and attributed to other causes. There is now no question, from recent developments, that the poisoning has been going on unsuspected in various sections of the city for years. Since my attention has been

[1] Whom I saw through the kindness of Dr. Isaac Mac Bride.

directed to the matter, I have been surprised, in looking over the mortuary records of the past few months, to see the large number of deaths returned as convulsions. The matter seems to deserve more attention from the profession than it has yet received.

The gums of 89 per cent. (57) of the 64 showed the "blue line" and it probably existed also in 6 of the remaining 7 cases, but was not looked for. In 24 of the cases the "line" was very marked above and below on the labial and lingual surfaces of the gums, about the necks of the teeth, and was accompanied by more or less retraction of the gum, which bled readily when subjected to even light friction. In 8 of these, who were intensely saturated with lead, the retraction was extreme and the borders of the affected gums looked as if fringed, displaying much of the neck surface of the teeth, which were usually of a brown color. In 16 there was a moderately well-marked "line," either below or above, in the edge of the gum about the necks of the incisors, canines or bicuspids. In these the retraction of the gum was not great, but the thin edge of the mucous membrane grasping the neck had become atrophied, and the edge of the gum containing the deposited metal could be readily separated from the neck and a portion of the fang of the tooth. In 17 the "line" consisted of either a faint, bluish-black streak, limited to the mucous membrane grasping the neck, or of a number of fine bluish-black dots as described in the case of Mrs. V. G., irregularly distributed within the same portion of gum; these dots, or the streak which seemed to be simply an aggregation of them, were most frequently limited to a portion of gum grasping a single tooth, often one of the bicuspids or anterior molars, so that care had to be taken that it was not

overlooked. The "line" in most instances was more marked below than above, and much more pronounced on the labial than on the lingual surface. A severe case was seen in that of the wife of one of the bakers, who was thoroughly saturated with the metal. The labial surface of the whole gum in the upper and in the lower jaw was deeply dyed, beside there being a deep line in the gums at their junction with the teeth.

The mortality in the 64 thus far is 12.5 per cent. The 8 deaths were among the eclamptic cases, making a death-rate in the latter of 72.72 per cent. If with these 8 the 3 were included, mentioned in the foot note on page 756, the general mortality would be raised to 16.41 per cent., or 11 deaths out of 67, and the mortality in the eclamptic cases would reach 78.57 per cent., or 11 deaths out of 14.

It is worthy of note that in the viscera of all of the 5 fatal cases examined by Drs. Reese[1] and Leffmann lead was found, and in 4 in notable quantities. It was encountered in large quantities in the liver. In only 2 of the 5 were the brain and spinal cord examined; these organs yielded to several tests distinct evidence of its presence, which indicates that it would probably have been found in the same organs in all had they been examined.

In conclusion I desire to express my thanks to Dr. Leffmann for examining the urine of several of the cases for lead, to Dr. Hansell for eye examinations, to Drs. E. Hellyer, Isaac MacBride, and W. K. Brown, for permitting me to see and study their cases, and to Drs. A. A. G. Starck and W. G. Bobb for histories of their cases, some of which I have used in the preparation of this paper.

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